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Engineering Economic Analysis Of The Use Of Cummins Diesel Engines Viewed From Fuel Cost

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Abstract

This study analyzes the economic efficiency of Cummins diesel engines with a focus on fuel costs. Cummins diesel engines are used in power generation systems due to their reliability and fuel flexibility. The analysis employed a library research approach to examine the relationship between fuel consumption, engine performance, and operational costs. Results indicate that fuel consumption, fuel type, load, and operating duration affect economic efficiency. Effective fuel management strategies, including proper fuel selection, optimized operation scheduling, and regular engine maintenance, can enhance cost efficiency while maintaining engine performance.

Keywords:diesel; cost; efficiency; fuel; Cummins

INTRODUCTION

The use of diesel engines remains the primary choice across various industrial sectors, power generation, and energy systems because of their ability to produce large, stable, and sustained power output. Diesel engines are known for their relatively high thermal efficiency and strong operational durability under heavy working conditions and long operating periods. One widely used brand is Cummins, which has a strong reputation for performance and reliability. However, amid rising energy demand, fuel cost has become a dominant factor strongly influencing the total operating cost of diesel engines,

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making it necessary to conduct a study that considers not only technical aspects but also a thorough economic perspective (Tambunan et al., 2023).

Fuel, as the primary energy source of a diesel engine, plays an important role in determining engine performance and the level of energy consumption. Differences in fuel characteristics can affect the combustion process, the power produced, and specific fuel consumption. Certain fuel treatments and types have been shown to increase or decrease the power and torque of diesel engines, which ultimately affects fuel-use efficiency. Therefore, fuel consumption analysis is an important aspect for understanding the relationship between engine performance and the resulting operational costs (Allen, 2023).

In engineering studies, the engineering economics approach is used to evaluate a system based on the balance between the costs incurred and the benefits obtained. This analysis assesses not only the technical performance of the engine but also calculates operational costs in detail to determine the level of economic efficiency. Through the engineering economics approach, energy consumption can be converted into cost units, making it easier to assess the economic viability of an engine or power system. This approach has been widely applied in various energy-efficiency studies as a basis for technical and managerial decision-making (Biantoro, 2017).

Cummins diesel engines are widely applied in generator sets because of their flexibility in using various types of fuel and their ability to maintain performance under varying loads. The use of different fuels can affect engine performance, including combustion efficiency and fuel consumption. This shows that even though an engine has the same technical specifications, the resulting operational cost can differ depending on the type of fuel used. For this reason, Cummins diesel engines are a relevant object of analysis from an engineering economics perspective (Gultom et al., 2025).

Fuel consumption analysis is applied not only to power generation systems but also to various energy and transportation systems to assess the efficiency of resource use. Studies related to fuel consumption show that the amount of fuel used has a direct correlation with a system's operational cost. Evaluating fuel consumption enables more accurate cost calculations in both the short and long term. This approach is important to ensure that a system can be operated efficiently and economically (Alfendry et al., 2018).

Feasibility studies of diesel-based power system operations show that fuel cost is the largest component affecting operational sustainability. Fluctuations in fuel prices can significantly impact the total cost of energy production, making fuel-cost analysis a crucial factor in the planning and operation of diesel systems. Therefore, engineering economic

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analysis is needed to determine the extent to which the operation of a diesel engine remains economically feasible and able to meet energy needs optimally (Sihombing et al., 2025).

Based on these issues, an engineering economic analysis of the use of Cummins diesel engines viewed from fuel cost is required. This analysis aims to determine the level of economic efficiency of fuel use in engine operations and to provide an overview of the costs incurred to generate power. The results of the analysis are expected to serve as a basis for consideration in operational management and decision-making related to the use of Cummins diesel engines so that they can be more effective and efficient.

METHODS

The research method used in this study is qualitative, employing a library research approach, in which data collection and analysis are carried out through literature review from various relevant sources, such as journals, articles, and technical documents related to Cummins diesel engines, fuel consumption, and engineering economic analysis. This approach allows the researcher to understand existing concepts, theories, and data, which are then examined in depth to obtain a comprehensive understanding of fuel-cost efficiency and the economic viability of using diesel engines. The results of this literature review are then analyzed systematically to formulate conclusions and recommendations consistent with the research objectives.

DISCUSSION

Characteristics and Specifications of Cummins Diesel Engines

The Cummins diesel engines used in power generation systems have the main characteristic of being able to produce stable power with a high level of reliability. These engines are designed to operate over long periods with a relatively constant workload, so they are widely used in medium- to large-scale generator sets. Technical specifications such as power capacity, the combustion system, and internal component design greatly affect the engine's overall performance and serve as an initial factor in the engineering economic analysis (Tambunan et al., 2023).

In terms of performance, Cummins diesel engines are known to have an efficient combustion system capable of optimizing the energy produced from fuel. The engine's sturdy design allows it to operate under a variety of environmental conditions without a significant drop in performance. This makes Cummins diesel engines a widely used

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choice in power generation systems that demand continuity and reliability of power (Purnama & Saksono, 2015).

Beyond performance, the characteristics of Cummins diesel engines are also examined in terms of their ability to use various types of diesel fuel. This flexibility provides operational advantages, but on the other hand creates variation in fuel consumption and operational costs. Therefore, the technical specifications of Cummins diesel engines form an important basis for further analysis related to fuel consumption and economic efficiency (Gultom et al., 2025).

The Concept of Engineering Economic Analysis in the Use of Diesel Engines

Engineering economic analysis is an approach used to evaluate an engineering system by comparing the costs incurred with the benefits or output obtained. In the use of diesel engines, this approach aims to assess the extent to which the engine can operate cost-efficiently, particularly regarding fuel cost as the main component of operational expenditure. Through engineering economic analysis, cost calculations can be carried out systematically and measurably to determine the level of economic viability of using a diesel engine. This approach is very important in determining the effectiveness of energy resource use (Biantoro, 2017).

In the context of diesel engines, engineering economic analysis considers not only technical aspects such as power, performance, and reliability, but also accounts for energy consumption, which is then converted into operational cost. Fuel cost is the main focus of the analysis because it has the most significant influence on the total operating cost of a diesel engine. By incorporating cost aspects into technical evaluation, the engineering economics approach is able to provide a more comprehensive picture of the efficiency of diesel engine use in operational activities (Alimuddin & Herudin, 2016).

The application of engineering economic analysis to Cummins diesel engines makes it possible to evaluate the feasibility of engine use over a given period, both for short-term and long-term use. Through this analysis, it can be determined whether the fuel cost incurred is still commensurate with the energy or power produced by the engine. The results of engineering economic analysis become an important basis for decision-making related to operational management and the planning of diesel-based power systems so that they can run efficiently and economically (Sihombing et al., 2025).

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Fuel Consumption of Cummins Diesel Engines

Fuel consumption is the main indicator for assessing the level of operational efficiency of a Cummins diesel engine because it directly reflects the engine's ability to convert fuel energy into power. The level of fuel consumption is influenced by various factors, including engine workload, the type of fuel used, and operating conditions while the engine is running. The higher the fuel consumption required to produce a given amount of power, the greater the cost that must be incurred in operating the engine. Therefore, fuel consumption is an important parameter in the technical and economic analysis of diesel engine use (Allen, 2023).

Observations show that Cummins diesel engines exhibit varying levels of fuel consumption depending on the type of fuel used. Differences in fuel characteristics, such as calorific value and combustion properties, cause changes in the combustion process inside the engine that affect the resulting energy efficiency. This condition shows that selecting the right fuel affects not only engine performance but also the overall level of fuel consumption. Thus, fuel type is an important factor in efforts to improve the operational efficiency of Cummins diesel engines (Tambunan et al., 2023).

In addition to fuel type, engine operating load also has a significant effect on the fuel consumption of Cummins diesel engines. Under higher-load conditions, the engine requires more energy to meet the power demand, so fuel consumption tends to increase. This indicates a direct relationship between engine workload and the amount of fuel used during operation. Therefore, variations in operating load need to be carefully accounted for in fuel consumption analysis and the economic evaluation of diesel engines (Gultom et al., 2025).

High fuel consumption directly increases the operational cost of diesel-based power generation systems. The magnitude of fuel consumption determines the total fuel cost that must be incurred over a given operating period. Therefore, fuel consumption analysis is a very important basis for calculating fuel cost and evaluating the economic efficiency of using Cummins diesel engines. Fuel consumption data is used as the main input in operational cost calculations to obtain an overall picture of a system's economic viability (Allen, 2023).

Calculation of Operational Fuel Cost

The calculation of operational fuel cost is carried out based on the level of fuel consumption of the Cummins diesel engine and the price of the fuel used during operation. This cost is calculated to determine the amount of expenditure required to run

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the engine over a given operating period. Accurate fuel-cost calculation is needed to provide a realistic picture of the operational cost burden of a diesel-based power system. Accordingly, this calculation becomes an important basis in engineering economic analysis (Biantoro, 2017).

Operational fuel cost is the largest cost component in a diesel-based power system compared with other operational cost components. Every increase in fuel consumption directly impacts the increase in the engine's total operating cost. Therefore, fuel-cost calculation needs to be carried out in detail and systematically so that the level of economic efficiency of diesel engine use can be determined. This analysis is important for controlling operational expenditure so that it remains at an economical level (Alimuddin & Herudin, 2016).

In this analysis, fuel cost is calculated based on engine operating hours and fuel consumption per unit of time. This approach allows cost evaluation to be carried out for both short-term and long-term periods, according to the duration of engine operation. With this calculation method, operational costs can be projected more measurably to support the planning and management of sustainable Cummins diesel engine use (Putera et al., 2021).

The results of the operational fuel-cost calculation show that the size of the cost is heavily influenced by the level of efficiency of the engine's fuel consumption. Engines with more efficient fuel consumption tend to produce lower operational costs compared with engines with high fuel consumption. This confirms that fuel consumption analysis plays an important role in operational cost calculation and the economic evaluation of diesel power systems (Sihombing et al., 2025).

Fuel Cost Efficiency Analysis

Fuel cost efficiency analysis aims to assess the extent to which fuel use in Cummins diesel engines is able to provide optimal economic benefit. Cost efficiency is achieved when the energy or power produced by the engine is commensurate with the fuel cost incurred during operation. In other words, the greater the energy output produced with a relatively low fuel cost, the higher the level of cost efficiency achieved. This analysis is an important indicator in the engineering economic evaluation used to assess the feasibility of using a diesel engine (Biantoro, 2017).

Fuel cost efficiency is strongly influenced by engine performance and the characteristics of the fuel used. Engines with a more optimal combustion system are able to produce greater energy with relatively lower fuel consumption. This condition shows

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that an engine's technical efficiency is directly linked to the resulting operational cost efficiency. Therefore, improving engine performance can have a positive impact on reducing overall fuel cost (Allen, 2023).

The analysis results show that Cummins diesel engines have different levels of cost efficiency across variations in the fuel used. These differences in efficiency levels are caused by the combustion characteristics and calorific value of each fuel. Fuel with a higher calorific value tends to produce greater energy with more efficient consumption. Therefore, selecting the right fuel is an important factor in efforts to improve the operational cost efficiency of Cummins diesel engines (Tambunan et al., 2023).

Fuel cost efficiency analysis also shows that an increase in fuel consumption is directly proportional to a decrease in the engine's economic efficiency level. The greater the amount of fuel used, the higher the operational cost that must be incurred over a given period. This condition can increase the operational cost burden in the long term. For this reason, fuel efficiency is a highly crucial aspect in the management and operation of diesel engines (Alimuddin & Herudin, 2016).

Overall, fuel cost efficiency can be used as a basis for evaluation in determining the operational strategy of Cummins diesel engines. This analysis provides a clear picture of the level of economic viability of engine use based on the fuel cost incurred. In addition, the analysis results can help in decision-making related to fuel management so that the use of Cummins diesel engines can proceed more effectively, efficiently, and sustainably (Sihombing et al., 2025).

Economic Evaluation of Cummins Diesel Engine Use

The economic evaluation of Cummins diesel engine use is conducted to assess the operational feasibility of the engine based on the amount of fuel cost incurred during operation. This evaluation considers the relationship between the level of fuel consumption, total operational cost, and the energy or power produced by the engine. Through this approach, fuel use is viewed not only from a technical standpoint but also in terms of its impact on cost and operational sustainability. Thus, economic evaluation becomes an important tool for determining whether the use of Cummins diesel engines still provides economic benefit (Sihombing et al., 2025).

The evaluation results show that fuel cost has a very dominant influence on the total operational cost of Cummins diesel engines. An increase in fuel consumption directly causes an increase in operating cost, which can reduce the overall level of the system's economic efficiency. Therefore, controlling fuel consumption through load management

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and appropriate fuel selection is an important step in improving economic efficiency. This economic evaluation provides a strong basis for system managers in formulating more effective and efficient operational strategies and planning (Biantoro, 2017).

The Influence of Workload and Operating Hours on Fuel Cost

Engine workload is one of the main factors influencing the level of fuel consumption in Cummins diesel engines. Engines operated under high load require more energy to produce the required power, so fuel consumption increases. Conversely, a lighter load tends to result in lower fuel consumption; however, if the engine is operated for too long under low load, combustion efficiency can also decline. Therefore, engineering economic analysis needs to account for variations in workload when calculating operational costs so that cost estimates are more accurate (Allen, 2023).

In addition to workload, operating hours or the duration of engine operation also have a significant influence on total fuel cost. An engine that operates longer will consume more fuel, so total operational cost increases along with increasing working hours. This is important to consider in the operational planning of diesel power systems, particularly for determining an optimal operating schedule so that fuel consumption remains efficient and costs do not balloon (Gultom et al., 2025).

Variations in workload and operating hours affect not only fuel consumption but also overall engine performance. Operation under high load for a long period can increase the risk of component wear and reduce combustion efficiency. Therefore, monitoring and managing load and operating duration are very important for maintaining the balance between engine performance and fuel cost efficiency (Tambunan et al., 2023).

A careful evaluation of the influence of workload and operating hours enables managers of Cummins diesel power systems to make data-based decisions. By understanding the relationship among load variation, operating duration, fuel consumption, and operational cost, management can determine an optimal operating strategy. This not only reduces fuel cost but also extends the engine's service life and improves the overall economic viability of the system (Sihombing et al., 2025).

Fuel Management Strategies to Improve Economic Efficiency

Effective fuel management is one of the important strategies for improving the economic efficiency of Cummins diesel engine use. This strategy may include selecting fuel types with a high calorific value and optimal combustion characteristics, so that the energy produced is maximized with relatively lower fuel consumption. Selecting the right

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fuel has a direct impact on cost efficiency and engine performance (Tambunan et al., 2023).

In addition to fuel selection, management strategies can be carried out through optimizing the engine's operating schedule. For example, the engine can be operated during certain hours at an optimal load to minimize fuel waste. This approach allows fuel consumption to remain controlled without reducing the power capacity produced by the diesel engine. Such operational planning is very important for maintaining the balance between cost and energy output (Alimuddin & Herudin, 2016).

Fuel management strategy can also include periodic monitoring and maintenance of the diesel engine. A well-maintained engine will have a more efficient combustion system, resulting in lower fuel consumption compared with an engine experiencing wear or technical problems. Thus, a maintenance strategy not only improves engine performance but also significantly reduces operational costs (Gultom et al., 2025).

Overall, the comprehensive implementation of fuel management strategies can improve the economic efficiency of Cummins diesel engine use. The combination of proper fuel selection, operating schedule optimization, and engine maintenance allows fuel cost to be reduced without decreasing the power output produced. This strategy is an important basis for operational decision-making so that Cummins diesel power systems can run more effectively, efficiently, and economically over the long term (Sihombing et al., 2025).

CONCLUSION

Based on the results of the analysis, the use of Cummins diesel engines shows that operational economic efficiency is strongly influenced by fuel consumption, the type of fuel used, and the engine's workload and operating duration. Proper fuel management and operational planning make it possible to reduce operational costs while maintaining engine performance. Engineering economic analysis provides a comprehensive picture of the economic viability of diesel engine use, so that it can serve as a basis for decision-making to improve the effectiveness and efficiency of diesel power systems. With the application of good strategies, the use of Cummins diesel engines can proceed optimally, economically, and sustainably.

REFERENCES

Alfendry, A., Budiarto, U., & Kiryanto, K. (2018). Analisa Penerapan Diesel Waterjet Propulsion (DWP) Dan Electrical Waterjet Propulsion (EWP) Ditinjau Dari

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Konsumsi BBM Pada Kapal Patroli Imigrasi 14 Meter. Jurnal Teknik Perkapalan, 6(1).

Alimuddin, A., & Herudin, H. (2016). Analisa Efisiensi Konsumsi Energi Listrik Pada Kapal Motor Penumpang Nusa Mulia. Setrum: Sistem Kendali-Tenaga-Elektronika-Telekomunikasi-Komputer, 3(1), 54-60. http://dx.doi.org/10.36055/setrum.v3i1.499

Allen, R. V. A. (2023). Analisis Perlakuan Bahan Bakar Terhadap Tenaga dan Torsi yang Dihasilkan Mesin Diesel Serta Tingkat Konsumsi Bahan Bakar. Technologica, 2(2), 87-94. https://doi.org/10.55043/technologica.v2i2.104

Bambang Puguh Manunggal, S. (2019). Studi sistem bahan bakar gas pada superheater untuk pengembangan bahan bakar alternatif. Jurnal Teknik Energi, 9(1), 64-72. https://doi.org/10.35313/.v9i1.1647

Biantoro, A. W. (2017). Analisis perbandingan efisiensi energi pada gedung P Kabupaten Tangerang dan gedung tower UMB Jakarta. Jurnal Teknik Mesin Mercu Buana, 6(3), 164-173. 10.22441/jtm.v6i3.1966

Gultom, N., TK, B. F., & Muchammad, M. (2025). Studi Eksperimental Unjuk Kerja Diesel Generator Set Cummins Model N150g4 150 Kva Dengan Bahan Bakar B0, D35, B30d5 Dan B35. Jurnal Teknik Mesin, 13(3), 261-264.

Purnama, S., & Saksono, P. (2015). Analisa Perbandingan Aplikasi Sistem Satu dan Dua Tingkat Turbocaharger Terhadap Performansi Cummins Engine K38- C. JTT (Jurnal Teknologi Terpadu), 3(1). https://doi.org/10.32487/jtt.v3i1.51

Putera, N. Z. Q., Haryudo, S. I., & Kartini, U. T. (2021). Analisis Rugi Daya Untuk Unit Kilang Berbasis Etap 12.6.0 Di Pusat Pengembangan Sumber Daya Manusia Minyak Dan Gas Bumi (Ppsdm Migas) Cepu. Jurnal Teknik Elektro, 10(2), 435-442. https://doi.org/10.26740/jte.v10n2.p435-442

Sihombing, A. W., Erivianto, D., & Dalimunthe, M. E. (2025). Feasibility Analysis of Diesel Power Plant Operations (PLTD) in North Sumatra. Holistic Science, 5(1), 83-91. https://doi.org/10.56495/hs.v5i1.1028

Tambunan, C. N., Gantina, T., & Manunggal, B. (2023). Analisis Perbandingan Bahan Bakar Biosolar dan Dexlite terhadap Performansi Generator Set Tipe Cummins 60 kVA. Jurnal Teknik Energi, 12(2), 27-32. https://doi.org/10.35313/.v12i2.5227

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